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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/923,670	08/07/2001	Hag-ju Cho	5649-877	1538

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EXAMINER

THOMAS, TONIAE M

ART UNIT PAPER NUMBER

2822

DATE MAILED: 09/16/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/923,670

Applicant(s)

CHO ET AL.

Examiner

Toniae M. Thomas

Art Unit

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 06 August 2003.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 58-72 and 74-77 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☒ Claim(s) 62-69 and 77 is/are allowed.
- 6) ☒ Claim(s) 58-61, 70-72 and 76 is/are rejected.
- 7) ☒ Claim(s) 74 and 75 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 07 August 2001 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____.
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____.

DETAILED ACTION

1. The finality of the Office action mailed on 04 June 2003 is withdrawn.

Accordingly, the amendment filed on 06 August 2003 under 37 CFR §1.116 has been entered. Currently, claims 58-72 and 74-77 are pending.

2. In the final Office action mailed on 04 June 2003, the examiner indicated that claim 61 and claim 73 (now cancelled) were objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims. The indicated allowability is withdrawn in view of further consideration of the cited reference Hendrix et al. (US 6,204,158 B1), which was cited in the final action mailed on 04 June 2003, but not relied upon. A rejection based on the Hendrix patent follows.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless -

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

3. *Claims 58-61, 71, and 72 are rejected under 35 U.S.C. 102(e) as being anticipated by Hendrix et al. (US 6,204,158 B1).*

The Hendrix et al. patent (Hendrix) describes a method for fabricating a capacitor for a semiconductor memory device, wherein the capacitor comprises a ferroelectric dielectric region 255 (see figs. 3A, 3B, and col. 5, line 9 – col. 8, line 42). The method comprises the following steps: depositing a first layer 275 of a different material than the ferroelectric dielectric region directly on a surface of the ferroelectric dielectric region 255, wherein a first metal oxide layer can be used for the first layer (fig. 3B and col. 7, lines 22-42);¹ annealing the first layer and the ferroelectric dielectric region (col. 7, lines 51-63); and depositing a second layer 257 on the first metal oxide layer, wherein a metal oxide layer can be used for the second layer (col. 8, lines 18-24).^{2,3} In the instance where a metal oxide layer is used for the first and second layers, the first layer forms a first metal oxide layer, and the second layer forms a second metal oxide layer. The first and second layers are non-ferroelectric material layers.

The first layer is sufficiently thin enough to enable a remnant polarization of the ferroelectric dielectric region to increase during the annealing step (col. 7, lines 49-55).⁴

¹ Note: layer 255 in figure 3B is referred to as “metal oxide layer 555” in col. 7, lines 22-42. However, layers 255 and 555 are one in the same.

² Note: layer 275 in fig. 3B is referred to as “scavenger layer 575” in col. 7, lines 22-42. However, layers 275 and 575 are one in the same.

³ At col. 8, lines 24-23, Hendrix indicates that the materials used to form layer 253 can also be used to form layer 257. At col. 6, lines 18-21, Hendrix indicates that metal oxides such as IrO_x, RhO_x, RuO_x, OsO_x, ReO_x, and WO_x can be used for layer 253. Thus, Hendrix teaches that the second layer can be a metal oxide layer.

⁴ The thickness of layer 275 does not inhibit the improvement of the remnant polarization during the annealing step.

The first layer and the ferroelectric dielectric region are annealed in a manner sufficient to increase the remnant polarization of the ferroelectric dielectric region (col. 7, lines 51-57).

The first layer 275 is sufficiently thick enough to reduce diffusion of hydrogen into the dielectric region 255 during the depositing of the second layer 257. Hendrix indicates that the first layer 275, which can be a metal oxide layer such as TiO_2 , ZrO_x , or TaO_x , is formed to a thickness of about 1-10 nm (col. 7, lines 49-50). TiO_2 , ZrO_x , and TaO_x are known to have a high resistance to hydrogen diffusion. A material that is known to have a high resistance to hydrogen requires a smaller thickness than a material known to have a lesser resistance to hydrogen. Since TiO_2 , ZrO_x , and TaO_x are known to have a high resistance to hydrogen diffusion and can be used to form the first layer 275, it stands to reason that the thickness of the first layer 275 is sufficient to reduce the diffusion of hydrogen into the dielectric region.

The ferroelectric dielectric region 255 is a capacitor dielectric. The ferroelectric dielectric region comprises a ferroelectric material selected from the group consisting of SrTiO_3 , BaTiO_3 , $(\text{Ba}, \text{Sr})\text{TiO}_3$, $\text{Pb}(\text{Zr}, \text{Ti})\text{O}_3$, $\text{SrBi}_2\text{Ta}_2\text{O}_9$, $(\text{Pb}, \text{La})(\text{Zr}, \text{Ti})\text{O}_3$ and $\text{Bi}_4\text{Ti}_3\text{O}_{12}$ (col. 6, lines 41-62).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

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(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. *Claim 70 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hendrix in view of Hermes (US 6,188,100 B1).*

Hendrix discloses the use of CVD to deposit the first layer 275 (col. 7, lines 25-27).

However, Hendrix does not teach that the second layer 257 is deposited according to one of an atomic layer deposition method, a low pressure chemical vapor deposition method, a high pressure chemical vapor deposition method, a plasma chemical vapor deposition method or a chemical vapor deposition method.

Hermes describes a method for fabricating a capacitor for a semiconductor memory device (figs. 1-17 and accompanying text), wherein the capacitor comprises a ferroelectric dielectric region 156 (fig. 14 and col. 5, lines 1-6). The method comprises depositing a conductive layer 157 using CVD, wherein the conductive layer forms the top electrode of the capacitor (fig. 15 and col. 5, lines 13-23). Metal oxides such as RuO_2 , IrO_2 , and RhO_x can be used for layer 157.

Since both layer 257 (Hendrix) and layer 157 (Hermes) form top electrodes of a capacitor used in a semiconductor memory, and since metal oxides such as RuO_2 , IrO_2 , and RhO_x can be used for both layer 257 and layer 157, the use of CVD as disclosed by Hermes would have been recognized in the pertinent art of Hendrix by one of ordinary skill in the art at the time the invention was made.

One having ordinary skill in the art would have been motivated to modify the method described in Hendrix, at the time the invention was made, by depositing the second layer 257 using CVD, as taught by Hermes, since high purity deposits can be achieved, and good economy and process control are possible.

5. *Claim 76 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hendrix.*

Hendrix does not teach that the second metal oxide layer is thicker than the first metal oxide layer. However, forming the second metal oxide layer, which forms the top electrode of a capacitor, so that it is thicker than the first metal oxide layer is within ordinary skill of one in the art. Accordingly, the limitation "wherein the second metal oxide layer is thicker than the first metal oxide layer" is taken to be obvious over Hendrix.

Allowable Subject Matter

6. *Claims 62-69 and 77 are allowed.*

Claims 62-69 and 77 are allowed because the prior art of record does not anticipate, teach or suggest a method of forming a protective structure for a ferroelectric dielectric region, the method comprising the steps substantially as claimed in claim 62, wherein the second metal oxide layer comprises a metal oxide selected from the group consisting of Al_2O_3 , TiO_2 , ZrO_2 , Ta_2O_5 and CeO_2 . As discussed above, Hendrix, which is the closest prior art of record, discloses a method for fabricating a capacitor for a

semiconductor memory device, wherein the capacitor comprises a ferroelectric dielectric region 255. The method comprises the following steps: depositing a first layer 275 of a different material than the ferroelectric dielectric region directly on a surface of the ferroelectric dielectric region 255, wherein a first metal oxide layer can be used for the first layer; annealing the first layer and the ferroelectric dielectric region; and depositing a second layer 257 on the first metal oxide layer, wherein a metal oxide layer can be used for the second layer. Again, in the instance where a metal oxide layer is used for the first and second layers, the first layer forms a first metal oxide layer, and the second layer forms a second metal oxide layer. Since the second layer 257 forms the top electrode of a capacitor, the material used for the second layer must be conductive. Since Al_2O_3 , TiO_2 , ZrO_2 , Ta_2O_5 and CeO_2 are non-conductive materials, there is no teaching or suggestion to modify Hendrix by using one of Al_2O_3 , TiO_2 , ZrO_2 , Ta_2O_5 and CeO_2 for the second metal oxide layer.

7. *Claims 74 and 75 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.*

Claim 74 would be allowable for the same reason as claims 62-69 and 77. Claim 75 would be allowable only because it depends from claim 74.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Toniae M. Thomas whose telephone number is (703)

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305-7646. The examiner can normally be reached on Monday through Thursday from 8:30 AM to 5:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Amir Zarabian can be reached on (703) 308-4905. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

JMJ

05 September 2003



AMIR ZARABIAN
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